

Bonobo Nutrition - Relation of Captive Diet to Wild Diet

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This section is intended to provide bonobo caregivers with a basis for comparing the diet of wild bonobos to the diet offered to captive bonobos. This brief treatment of the subject primarily cites information gathered at the two major research sites, Lomako and Wamba. Because most of the published information on wild bonobo diets has come from these two sites, intersite dietary differences are perhaps over-emphasized in this paper. It should be stressed that intrasite dietary variation between bonobo communities may be as great (or greater) than the intersite variation between Lomako and Wamba (Ono Vineberg pers. comm.) discussed below. As studies of wild bonobos continue, the range of variability in dietary patterns becomes more evident. This is not surprising, given the adaptability of bonobos to different foods in captivity.

Wild Diet

Wild bonobos, like chimpanzees (*Pan troglodytes*), have a very diversified diet. Like chimpanzees, bonobos are primarily frugivorous and supplement their diets with other plant and animal tissues. Besides fruit, wild bonobos consume terrestrial herbaceous vegetation (THV) in the form of leaves, shoots, flowers and pith. To a lesser extent than chimpanzees, bonobos also consume invertebrates and small vertebrates (Badrian and Malenky 1984; Kano 1992; Kano and Mulavwa 1984; Malenky 1990). According to Wrangham (1986), bonobos seem to be somewhere between chimpanzees and gorillas dietarily because bonobos utilize both THV and fruits. Gorilla diets consist primarily of THV, whereas chimpanzees consume significantly less THV and more fruit.

Reports from the two major bonobo field research sites, Lomako and Wamba, show both similarities and differences in the diets of the bonobo groups studied. At both research sites, bonobos utilize over 110 species of plants as food sources (Badrian and Malenky 1984; Kano 1992; Kano and Mulavwa 1984). The list of plant species for each site continues to grow with ongoing observations. Kano and Mulavwa (1984) estimate that bonobos at Wamba consume parts of 10 species of plants per day and 40 species per month. Although a large number of species are included in their diets, bonobos at both sites rely on 10 or less species to make up more than 80-90% of their diets.

Due to differences in forest ecology, plant species represented in the top-ten food item lists differ between the two sites. Leading both lists are trees of the genus *Dialium*. At both sites, trees of this genus are well represented in the forest and provide one of the more stable fruit sources for bonobos from October-February (Kano 1992). *Dialium* fruit is smaller than other fruits and can be quickly harvested by breaking off a twig or small branch filled with fruit. The twig or branch can then be carried off to a different location for ingesting of the fruit (Kano and Mulavwa 1984). The Lomako bonobos utilized 3 species of *Dialium* (Susman 1984) and the Wamba bonobos ate from 4 *Dialium* species (Kano 1992).

Only a few other plant species are shared in each site's top-ten list, and these differ in relative significance between the lists. At Lomako, two species of *Ficus* (figs) are included in the top-ten. Whereas Wamba lists only one species of *Ficus*, and it is an infrequently utilized food source. Other fruit-bearing species utilized at both locations are *Uapaca guineensis* (Family: Euphorbiaceae), *Anonidium mannii* (Family: Annonaceae), and *Pancovia laurentii* (Family: Sapindaceae).

The differing proportions of fruits in the bonobo diets recorded at each research site are linked to differences in forest ecology, which affect fruit availability. For instance, Kano and Mulavwa (1984) estimate that fruit comprises between 80-90% of the bonobos' diet at Wamba, whereas Badrian and Malenky (1984) estimate that only between 40-50% of the Lomako bonobos' diet consisted of fruit.

Second to an apparent preference for fruit, bonobos rely heavily on terrestrial herbaceous vegetation (THV) for food (Kano 1983; Wrangham 1986). THV is a widely available and non-seasonal food source for bonobos. THV, such as leaves, flowers, stems, pith and shoots, provides most of the bonobos' nutritional needs other than the carbohydrates and vitamins (especially C) obtained from fruit (Kano 1992). Malenky (1990) conducted a biochemical analysis of some of the THV species consumed by bonobos and concluded that THV is likely eaten for its high protein content. A preliminary nutritional analysis of THV species such as *Megaphrynium* and *Haumania* also indicates that these may be rich protein sources (Ono Vineberg unpub. data). While THV is usually eaten when fruit is also available, its relative importance is thought to increase during times of lower fruit abundance. At Wamba, Kuroda (1979) reported that African ginger (*Aframomum* sp.) and arrowroot (*Megaphrynium macrostachyum* and *Haumania liebrechtsiana*) provided 30% of the bonobos' major foods. Similar to chimpanzees, bonobos chew wadges of plant material to extract additional juices and nutrients from plants.

Bonobos, according to Tuttle (1986), are the most likely of the apes to share vegetal food. This sharing occurs not only among mothers and infants but also between all age/gender lines (Kuroda 1984). Bonobos have also been observed to share meat (Badrian and Malenky 1984; Hohmann and Fruth 1993).

While non-plant food sources make up a small proportion of the chimpanzee diet, they are thought to be an even smaller part of a wild bonobo's diet. Chimpanzees are known to prey upon young baboons and monkeys, and have engaged in cannibalism on rare occasions. None of these activities have been recorded for wild bonobos. In common with chimpanzees, bonobos have been observed to eat animal foods such as young duikers and insects. The most significant animal food source for bonobos is invertebrates, such as insects, insect larvae, earthworms and millipedes (Badrian et al. 1981; Susman et al. 1985). Susman et al. (1985) also observed bonobos eating mollusks. While bonobos are known to eat termites, no direct observations have been made of bonobos fishing for them with tools as chimpanzees do. Indirect evidence suggests that they may fish termites, however (Badrian et al. 1981). Vertebrate prey species appear to be much less common in the bonobo diet. In addition to duikers, bonobos have been observed eating squirrels on several occasions (Ingmanson and Ihobe 1992; Ihobe 1992; Dupain and Van Krunkelsven 1996) and, in one instance, a bat (Bermejo et al. 1994). Fecal evidence has also revealed the bones of snakes and shrews (Badrian et al. 1981; Susman et al. 1985). At both Lomako and Wamba, bonobos have been observed feeding on unidentified organisms along the edge of a stream. The rapid movements of the bonobos suggested that they were feeding on fish or shrimp (Badrian and Malenky 1984).

Relevance of Wild Diets to Captive Diets

Wild bonobos have a highly varied diet and utilize many different plant species, but, to date, the nutritional analysis of these plants is insufficient to permit detailed comparison of wild and captive diets.

One should remember that, in the wild, every species has adapted to a diet which enables it to survive and reproduce. This may not be a species' optimal diet, but rather a minimal diet to meet these needs. Although a wild bonobo's diet contains much fruit, a captive diet providing a similar proportion of fruit may not necessarily be in the individual's best interest for several reasons. The diversity of fruits that can be provided in captivity is limited in comparison to the variety available to wild bonobos, and may differ significantly in nutritional quality and digestibility. Furthermore, bonobos consume a significant amount of THV, a major source of protein. Considering the importance of THV in the wild diet, a captive diet should balance the carbohydrates available in fruit with protein from food items such as vegetables, roots, tubers, monkey chow, and browse. Browse also provides captive bonobos with physical and psychological stimulation, similar to the THV feeding by their wild counterparts.

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Bonobo SSP Initial Dietary Survey

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The following is a summary of the results of a bonobo dietary survey distributed to SSP institutions in 1995-1996. Six facilities housing bonobos participated in the survey: the Cincinnati Zoo, Columbus Zoo, Fort Worth Zoo, Milwaukee County Zoo, San Diego Wild Animal Park and San Diego Zoo. Dietary information for EEP institutions is presented at the end of this section.

This section summarizes diets currently provided by each institution. No overall dietary analysis has been done. Therefore, no recommendations are made regarding ideal nutrition, nor is any interpretation or evaluation of the results offered.

FEEDING

Responses to the general dietary questions indicated that all institutions feed bonobos in a group setting. Some animals were fed in isolation when they were ill, in training, or in need of medications and special dietary supplements.

In Milwaukee, Linda was separated for feeding in order to permit more control of her weight and diabetes. Kitty, an aged and blind individual in Milwaukee, was also fed separately due to her need for medication and her slow-paced eating. Kidogo, an individual with a severe heart condition, was sometimes fed alone when he appeared weak and lethargic.

At the San Diego Zoo, an adult male was separated for feeding due to injuries inflicted in a fight. San Diego also occasionally allowed young bonobos to feed separately in a room adjacent to the adult area.

Bonobo keepers in Cincinnati, Columbus and the San Diego Wild Animal Park fed a few items to some bonobos by hand in order to maintain contact with the bonobos and more easily administer medicine. In Cincinnati, the bonobo keepers also fed some of their bonobos in isolated environments. For example, Louise, an overweight adult female, was fed separately (or with Virgil for companionship). Lisa, another adult female, was also fed alone (or with Lucy and/or Virgil) because of aggression by an adult male, Vernon, and her need to gain weight.

FEEDING SCHEDULE AND SEXUAL ACTIVITY

Each bonobo facility observed socio-sexual behaviors such as G/G rubbing, copulation, mounting, and erections during feeding times. In general, each facility reported seeing this activity on a frequent and regular basis. However, Fort Worth (with an all-male group) reported seeing socio-sexual activity during feeding on an occasional basis. Each facility reported that sexual activity increased during feeding.

According to all respondents, periods of increased sexual activity corresponded with the feeding schedule, which ranged between 2-4 times a day. The majority of institutions reported that feedings occurred at approximately 7 a.m., 12 p.m. and 4 p.m. Two institutions reported varying their feeding schedules based on alternating keeper schedules and timing of bonobo behavior-training sessions.

FOOD DISTRIBUTION

Each facility distributed provisions fairly evenly over the feeding area. Most of the food items were scattered on the floor. Four of the institutions hid food in bags, puzzle boxes, milk cartons, etc. or broadcasted small items in the grass, etc. to encourage foraging activity.

FOOD AS REWARD

Aside from the San Diego Wild Animal Park, each facility reported using food as a reward. Columbus occasionally employed food as a treat during bonobo transferring events. Fort Worth also occasionally used food as a reward when delivering medicine or shifting individuals. These "rewards" included raisins, grapes, peanuts, bananas, and peanut butter. Furthermore, Milwaukee and Cincinnati used food to reinforce behaviors during training sessions. Milwaukee used sugar and fat-free cookies, Kool-aid, juice, grapes, and bananas. Cincinnati used "rewards" including apples, crackers, sunflower seeds, low-fat chips, pretzels, and party mix. The San Diego Zoo utilized raisins, sunflower seeds, and melon segments as training rewards and to administer medication.

BEDDING

Each facility employed various materials as bedding. Cincinnati used straw, newspaper, fabrics, hay, and toilet paper. Columbus used pampas grass, woodwool, hay, and bamboo. Fort Worth used Sudan or coastal hay. Milwaukee used straw, woodwool, shavings, burlap bags, and blankets. The San Diego Wild Animal Park used woodwool, Sudan hay and timothy. The San Diego Zoo used woodwool and palm fronds. Other than Fort Worth and Cincinnati, each institution reported that bonobos consume some of the bedding material. Columbus identified hay and stick consumption. Milwaukee reported ingestion of alfalfa. The San Diego Wild Animal Park reported ingestion of Sudan hay.

WATER

Common water sources included pools and "Lixit" devices, which are nipple-like water-flow regulators that release water only when an animal places pressure on the regulator while drinking. Columbus provided water via a waterfall and bowls. Fort Worth provided water via a stream and hoses.

With the exception of the San Diego Zoo, all respondents reported observing bonobos playing in water. In Columbus, bonobos dipped paper and cardboard into water. They also placed water in a tub or hard hat to transport it. Bonobos at Fort Worth ran through the pool, clapping their hands and feet in the water. In addition, they tossed water at keepers. The bonobos in Milwaukee have been observed splashing, wading, and floating toys and food in their shallow pool. The bonobos in Cincinnati were observed dunking their heads into the water and splashing it with their feet.

FORAGE AND BROWSE ITEMS

Cincinnati provided 2 cups of foraging mix per animal, consisting of 3-4 of the following items: sunflower seeds, peanuts, popcorn, spaghetti, various noodles, biscuits, cereals, baked chips, party mix, brazil nuts, cashews, Pretty Bird Hi-Energy and diced/shredded vegetables. Cincinnati provided 1 bushel of browse per bonobo, containing a mixture of the following: mulberry, crown vetch, viburnum, honeysuckle, grape vine, willow, rhubarb, and maple (all browse washed with a hose after cutting). Milwaukee specified forage items such as popcorn (1-2 cups/bonobo), raisins (20/bonobo), cereal (half-cup/bonobo) and peanuts (10-15/bonobo). Browse items were also specified, including willow, ash, mulberry, maple and ficus. These items were supplied according to availability. Fort Worth included bamboo and Georgia cane in their browse item list. The San Diego Wild Animal Park provided acacia, mulberry, ginger, bananas, and sugar cane as browse. The San Diego Zoo specified raisins, sunflower seeds, apples, and air-popped popcorn as forage items. They also indicated using *Ficus benjamina*, *F. carica*, *F. rubiginosa*, *F. thonningii*, *Hibiscus rosa-sinensis*, *Morus alba* (mulberry), *Musa* sp. (banana), *Ensete* sp., and *Harpephyllum kaffra* as browse.

DIETARY SUPPLEMENTS

Daily dietary supplements employed by Columbus included Super Acerola (500 mg natural vitamin C) and Mazuri Vita-Zu brand vitamin supplement. Milwaukee provided their bonobos with Vidaylin vitamins, as well as providing Ensure to an underweight bonobo with congestive heart failure. Cincinnati supplemented the bonobo diet with children's chewable multi-vitamins for each animal.

DIETARY PROBLEMS

Milwaukee identified some dietary problems attributed to physical conditions, including a peanut allergy, and weight problems which affect individual daily diets.

BEHAVIORAL ENRICHMENT FOOD ITEMS

Cincinnati reported using coconuts, cake, candy, and honey as part of their behavioral enrichment program. The Columbus Zoo reported using Ash (*Fraxinus*) tree leaves and branches, bamboo, bananas, ficus, grapes, forsythia, vitamins, hardy pampas grass, and willow (*Salix*). Fort Worth smeared peanut butter, yogurt, and oatmeal throughout their exhibit areas. Similarly, the San Diego Wild Animal Park placed honey in log holes, which encourages foraging with tools. They also provided sunflower seeds, raisins, peanuts, and grapes to promote foraging. Milwaukee used herbs, spices, scent extracts, Kool-aid, sugar-free Jell-O, sugar-free chewing gum (on rare occasions), juices and cereals as part of their behavioral enrichment program.

AVERAGE DAILY DIET

All bonobo facilities provided a similar basic diet. The basic diet was composed of a varying mixture of carrots, assorted tubers, celery, apples, oranges, grapes, Romaine lettuce, bananas, raisins, green beans, and other assorted fruits and vegetables. Most items were presented in raw form, either whole or cut up.

Please refer to the following SSP and EEP survey results for details on basic daily diets at each bonobo facility.

SSP NUTRITION SURVEY RESULTS BASIC DAILY DIET

ADULT DIETS

Cincinnati Zoo -- Lucy/Lisa/Vernon

<u>Item</u>	<u>Quantity per bonobo per day</u>	<u>Preparation</u>
apples	2 per animal	quartered
oranges	2 per animal	quartered
bananas	2 per animal	whole
sweet potato	1 per animal	raw, sliced
white potato	1 per animal	raw, sliced
green beans	1 handful per animal	whole
celery	6 sticks per animal	full stick
Romaine lettuce	1/2 head per animal	quarter of head
carrots	2 per animal	raw, sliced
kale	4 per animal	whole
grapes	1 handful per animal	whole
corn	1 per animal (Thursday only)	on the cob
egg	1 per animal (Monday only)	cooked
cooked potato	1 per animal (Sunday only)	cooked

Cincinnati Zoo -- Louise/Virgil (overweight)

apples	1 1/2 per animal	See above
oranges	1 1/2 per animal	
bananas	2 per animal	
sweet potato	1/4 per animal	
white potato	1/4 per animal	
celery	8 sticks per animal	
lettuce	1 head per animal	
Romaine lettuce	1/2 head per animal	
carrots	2 per animal	
kale	3 per animal	
grapes	1 handful per animal	
corn	1 per animal (Thursday only)	
egg	1 per animal (Monday only)	

Columbus Zoo -- In response to this portion of the survey, Columbus submitted a daily diet description, including a nutritional analysis, for a diet provided to 4 adult bonobos. This has been reprinted by permission in Appendix 2.

Fort Worth Zoo

Item	Quantity per bonobo per day (divided into 2 feedings)	Preparation	
<u>Sunday through Saturday</u>			
Hi-Pro Monkey Chow	5 oz. per animal	All items fed raw. Most items	
apple	5 oz. per animal		
bananas quartered.	10.6 oz. per animal		
oranges	14.6 oz. per animal		
Romaine lettuce	27 oz. per animal		
kale	7 oz. per animal		
celery	30 oz. per animal		
carrots	8 oz. per animal		
turnips	9 oz. per animal		
sweet potato	14.6 oz. per animal		
white potato	10 oz. per animal		
<u>Sunday</u>			
kiwi	4 oz. per animal		
collards	7 oz. per animal		
green beans	4 oz. per animal		
<u>Monday</u>			
endive	5 oz. per animal		
broccoli	4 oz. per animal		
<u>Tuesday</u>			
grapes	2 oz. per animal		
mustard greens	5 oz. per animal		
onion	4 oz. per animal		
<u>Wednesday</u>			
kiwi	4 oz. per animal		
collards	7 oz. per animal		
green beans	4 oz. per animal		
<u>Thursday</u>			
melon	13.3 oz. per animal		
endive	5 oz. per animal		
green peppers	2.6 oz. per animal		
<u>Friday</u>			
broccoli	4 oz. per animal		
tomato	5 oz. per animal		
<u>Saturday</u>			
grapes	2 oz. per animal		
mustard greens	5 oz. per animal		
onion	4 oz. per animal		

Milwaukee County Zoo

Item	Quantity per bonobo per day
Purina Hi-Pro 9:00 a.m.	15-20 biscuits per animal
Purina Hi-Pro 4:30 p.m.	15-20 biscuits per animal
apples	1 per animal
oranges	1 per animal
yams	1/3-1/2 per animal, cooked/raw
bananas	2 per animal
grapes	10-15 per animal
endive	1/3 bunch per animal
kale	1/3 bunch per animal
spinach	5-6 leaves per animal
kiwi	1 per animal
pears	1-2 per animal
eggs	1/4 per animal, cooked
celery	3-4 stalks per animal
peanuts	10 per animal
raisins	10 per animal

*Some animals have special diets due to weight problems, allergies, or an inability to eat in a group setting.

San Diego Wild Animal Park -- In addition to the basic daily diet description below, the San Diego Wild Animal Park submitted a nutritional analysis for this diet (fed to 4 adult and 2 juvenile bonobos). This has been reprinted by permission in Appendix 2.

Item	Quantity per bonobo per day	Preparation
apples	2 1/2 per animal	All raw, whole or cut-up
orange	2-2 1/2 per animal	
celery	1/3 per animal	
Romaine lettuce	1/3 per animal	
banana	2-3 per animal	
carrot	1/2 per animal	
yam	1/2 per animal	
onion	1/6 per animal	
grapes	1/3 lb. per animal	
green beans	2 oz. per animal	
sunflower seeds	2 oz. per animal	
raisins	1/6 lb. per animal	
Science Diet - Zu/Preem	2 oz. per animal	

*Various foods are substituted in the basic diet, depending on what is available from the forage warehouse.

San Diego Zoo

Item	Quantity per bonobo per day	Preparation
onion	1/10 per animal	cut-up
cabbage	1/10 of a head per animal	cut-up
spinach	1/10 of a bunch per animal	whole leaves
melons	1/5 per animal	
Romaine lettuce	1/5 of a bunch per animal	whole leaves

kale	1/10 of a bunch per animal	whole leaves
collards	1/10 of a bunch per animal	whole leaves
grapes	1/10 of a bunch per animal	
apple	1 per animal (hand-fed in AM)	halved/quartered
orange	1 per animal (hand-fed in AM)	halved/quartered
banana	1 per animal (hand-fed in AM)	whole
yam	1 per animal (hand-fed in AM)	cut-up
carrot	1 per animal (hand-fed in AM)	whole/halved
papaya	1/4-1/2 per animal (hand-fed in AM)	cut-up
Zu/Preem biscuits	2 cups per animal (broadcast on floor)	

MATERNAL AND INFANT DIETS

Columbus included raspberry tea in the maternal diet (for herbal benefits) and Similac Low-Iron Infant Formula with Jungle Land Chewable Vitamins as part of the infant diet. The maternal diet at Cincinnati consisted of the basic diet distributed in greater quantities. The Cincinnati Zoo infant diet included Enfamil with iron and multi-vitamins. The San Diego Wild Animal Park included Iron Fortified SMA in the following SMA:water proportions: 1:3, 1:2, 1:1. In addition, baby cereal is included in the infant's diet. (See Section 1, Hand-Rearing of Infant Bonobos, in this chapter for more information on infant dietary requirements.)

The following is a detailed account of the San Diego Zoo's infant diet from day 1 to 16.5 months and Cincinnati's infant diet from day 1 to 183 days:

San Diego Zoo Infant Diet

Day	Item	Time (/day)	Quantity (/bonobo)	Preparation_____
1&2	Enfamil Low Iron	12X	30 mL	add boiled distilled water 1:2
3	Enfamil Low Iron	12X	30 mL	add boiled distilled water 1:1
10	Enfamil Low Iron	11X	35 mL	add boiled distilled water 1:1
15	Enfamil Low Iron	10X	45 mL	add boiled distilled water 1:1
24	Enfamil Low Iron	9X	55 mL	add boiled distilled water 1:1
30	Enfamil Low Iron & Enfamil w/ Iron	9X	55 mL	add boiled distilled water 1:1:2
32	Enfamil w/ Iron	8X	75 mL	add boiled distilled water 1:1
40	Enfamil w/ Iron	7X	100 mL	add boiled distilled water 1:1
44	Enfamil w/ Iron	6X	100 mL	add boiled distilled water 1:1
73	Enfamil w/ Iron	5X (on demand)	100 mL	add boiled distilled water 1:1
86	Gerber's Strained Rice, cereal w/ applesauce & bananas	5X	100 mL	mix with Enfamil formula

115	Enfamil formula & Gerber's mix	5X	120 mL	mix ingredients
123	Offer canned applesauce			mix with rice cereal
135	Add pears (jar)			mix with rice cereal
137	Add apples & bananas			mix with rice cereal
144	Add fresh banana	5X	150 mL	mix with rice cereal
223	Add fresh banana			mix with rice cereal
7 mo.	Add fresh papaya			
8 mo.	Add steamed carrots and yams with cereal			
8.5 mo.	Cereal discontinued, add fresh fruits and veggies (carrot, yam, broccoli, kale, Romaine lettuce, spinach, apple, banana, grapes, Zu/Preem primate biscuit)			chopped -- large enough for easy grasping
9 mo.	Enfamil w/ Iron	4X	150 mL	add water 1:1
9.5 mo.	Enfamil w/ Iron	3X	150 mL	add water 1:1
10.5 mo.	Enfamil w/ Iron	3X	200 mL	add water 1:1
12.5 mo.	Enfamil w/ Iron	2X	200 mL	add water 1:1
15 mo.	Adult diet & Enfamil	1X	200 mL	add water 1:1
16.5 mo.	Infant Weaned			

Cincinnati Zoo Infant Diet

Day	Item	Time (/day)	Quantity (/bonobo)	Preparation (by weight)
1	Enfamil w/ Iron	8X	20 cc	1.665 kg
4	Enfamil w/ Iron	8X	30 cc	1.665 kg
8	Enfamil w/ Iron	8X	35 cc	1.720 kg
15	Enfamil w/ Iron	8X	40 cc	1.835 kg
30	Enfamil w/ Iron	7X	50 cc	1.965 kg

40	Enfamil w/ Iron	7X	60 cc	2.145 kg
61	Enfamil w/ Iron	7X	70 cc	2.435 kg
81	Enfamil w/ Iron	6X	90 cc	2.700 kg
88	strips of apples, carrots, celery, and green beans in cage for infant to play with			
134	small pieces of cooked carrots, sweet potatoes, white potatoes, kale, bananas, and oranges			
143	Enfamil w/ Iron	5X	120 cc	3.225 kg
145	Enfamil w/ Iron & given fruit at night	5X	120 cc	3.225 kg
183	Enfamil w/ Iron	4X	150 cc	3.455 kg
306	Enfamil w/ Iron	4X	150 cc	4.160 kg

EEP NUTRITION SURVEY RESULTS BASIC DAILY DIET

BONOBO FEEDING AT BERLIN ZOO (3 adults)

8.00 - 10.00 Fruit and vegetables as available (season) cut in small pieces and hidden in the straw. Grains, seeds, leaves and chaff.

15.00 - 15.30 Individual feeding

Meat 1x/week, curd cheese 1x/week, more frequently eggs, seldom peanuts (reward)

Quantity: more than common chimpanzees, about half of the quantity for gorilla.

Tea in the afternoon

No feed supplements

Water:

Water is always available.

Enrichment:

Distribution of food in straw in the morning. In addition, sometimes we will use special places (holes in wood) to hide fruit or vegetables. The animals have to use tools (sticks) to get hold of the food.

Remarks:

- * grass is unfavorable, several times it caused diarrhea
- * there is always some food left
- * food offered at different feeding sites
- * ± fixed feeding times
- * they prefer vegetables more than fruit ('they like an onion more than an apple')

BONOBO FEEDING AT COLOGNE ZOO

The diet consists of all kinds of chopped vegetable and fruit. The following vegetables are offered: endive, chicory, celery, lettuce, carrots, cucumber, tomato, paprika, aubergine, onion, fennel, garlic, broccoli, cooked beans, celery, kohlrabi, maize, radish, soja bean sprouts, avocado. The following fruits are offered: apples, banana, orange, pear, melon, grapes, berries, ananas, kiwi, mango. Furthermore they get a porridge from curd cheese, skimmed milk, cooked meat (beef or chicken), dried dog food, monkey pellets, roasted soybeans, sunflower seeds, wheat, cooked rice, cooked potatoes, cooked eggs. Twigs and browse (weeping willow, maple, poplar, hazelnut, linden, mulberry, cotoneaster, oak, luzerne in summer, in winter alfalfa hay). Whole plants of maize, in winter ficus and tetrastigma from the jungle house)

6 times a day the bonobos get something to eat + 3 times drinking (milk and tea) + one time twigs and browse first feeding 8.00, last feeding 16.30

Food supplements:

The milk is enriched by vitamins, minerals, proteins, skimmed milk powder, dried rice water, yeast and bran.

Water:

They get their drinks from the keeper, but in summer the bonobos always have water in a water basin.

Enrichment:

Food is scattered in hay, straw, wood-wool, and leaves to encourage the bonobos to forage. Food is hidden in card boxes, wood sticks, tree-trunks a.s.o. instead of the normally chopped food, they also get root vegetables and big fruits uncut.

Remarks:

- * Three fixed feeding times, the other feeding times vary.
- * We feed such amounts that there is always some food left.
- * The food is distributed over the whole enclosure.
- * Normally we feed all together but since Kamiti is here, we separate Kindu for the main feedings. We distribute food before the animals enter their enclosure (after the cleaning), but normally we are feeding while they are present.
- * They like meat very much, they do not like eggs.

BONOBO FEEDING AT LEIPZIG ZOO (3 adults)

1,3 kg green leaves (lettuce sp., chicorée, parsley)
250 g dried parsley
5,2 kg root vegetables (leek, parsley root, celery, red beet, kohlrabi, cauliflower, both carrots and potatoes partly cooked and fresh)
3,5 kg apples
3 kg fruit (kiwi, orange, pineapple, grapefruit, banana, tomato and red pepper)

every two days 150 g yogurt

Drinks: herbal tea at 8.00 and 13.00

Feeding times: 8.00, 13.00, and 15.30

Food supplements:

2 times a week: multivitamin preparation, daily minerals supply and salt licking stone ad lib.

Water:

Water is always available.

Remarks:

- * Mofana does not get any banana (allergic reaction)
- * no fruit except apples during diarrhea periods, relatively often for Mofana.
- * fixed feeding times, always left-overs
- * food distributed before animals get into enclosure

Enrichment:

food hiding

BONOBO FEEDING AT PLANCKENDAEL ZOO (6 adults, 2 juveniles)

7.00 (individually fed in night cages)

per adult: 1 L milk
300 g apple
660 g banana

9.00

16.15 (winter) individually fed in night cages:
18.00 (summer)

per adult: 500 g monkey-cake
340 g oranges
200 g tomato
200 g chicory (Belgian endive)

distributed in indoor enclosure:

per adult: 350 g leek
350 g celery
180 g endive

Once a week 50 g egg per adult
Foliage is provided during the whole day

Food supplements:

all animals daily: 4 gram S.A.37, becozyme 1 drop per kg body weight

juveniles that are not weaned: daily D-cure in small meal balls
juveniles that drink cow milk already: daily D-cure + 1,5 gram pecutrine in milk

Water:

Water is always available, only one small disadvantage may be that the animals are not thirsty enough in the morning to drink vitamin solutions etc., when they have been able to drink ad lib as soon as they leave their nesting-sites. Even at night do the bonobos (pregnant and lactating) leave the nesting-site to drink!

Enrichment:

Every day something else:

- wooden block with holes that can be filled with honey, pinda-cheese, or small nuts or seeds, together with it branches are provided (sometimes too large, have to be adapted).
- small food-items or liquids (sometimes semi-warm) are hidden in other items;
 - in plastic-bottles filled with woodwool to block the raisins, seeds or nuts
 - in bags (jute) tied with small ropes
 - in crevices of the tree-trunks that furnish the hall
 - in car-tires we pour water
 - small posts, buckets or plastic covers are smeared with cheese (fresh), ligacé,
- On the islands different food-items are hidden between the bushes or in the trees or in the grass. The animals can also eat from the growing vegetation (report in prep., tables available)

Remarks:

- * Mothers + infants get a 10 minute 'UV bath' daily. This is, in combination with the D-cure, to avoid calcium-deficiency.
- * during the last years, we increased the number of feedings to give the animals more enrichment.
- * main meals (morning and evening): everything is eaten

- * food given in large indoor enclosure is sometimes widely distributed, sometimes given in a way that it can be monopolized.

BONOBO FEEDING AT STUTTGART ZOO (5 adults, 2 juveniles)

- * No food supplements.
- * ± Fixed feeding times
- * From time to time, depending on the animals' shape, we reduce the amount of raisins, nuts and grape-sugar fed, so that the bonobos do not get too fat.
- * Normally, everything is eaten.
- * Food is offered at different feeding sites.
- * It also depends on the individual animal, if it is sometimes fed separately: Zorba is fed separately, if favorite food items are given, because otherwise, as the lowest ranking animal, he would not get anything. Lina, too, is fed separately, if favorite food items are given, because otherwise alpha female, Kombote, would take everything for herself. If the whole group is fed together, food is distributed widely before the bonobos enter the enclosure.

Water:

During the day, our bonobos have access to fresh water all the time. Only some night quarters have a self service water source, and the bonobos do not use it. Sick animals get a supply of water (in a bucket) for the night, and if they are e.g. feverish, a keeper comes during the night to let them drink.

Enrichment:

- leaves and branches always keep bonobos occupied
- fishing cups (artificial termite mounds)
- wooden blocks with holes in which the bonobos can probe for raisins
- seeds widely distributed over the floor
- food put on the mesh roof
- salt block hanging over the mesh roof, which the bonobos can only reach with sticks
- boomer ball filled with peanuts and put on the mesh roof (the ball has only one or two holes through which a peanut can fall out)

BONOBO FEEDING AT TWYXCROSS ZOO (2 adults, 2 juveniles and 1 infant).

- 7.00 Skimmed milk with Ovaltine - approx. 2 pints per adult
- 8.00 Seed scattered in woodwool on floor of inside enclosure.
Mixed nuts, sunflower, rolled oats, flaked maize, raisins, sultanas and primate pellets - approx. 1 handful of each.

Breakfast (put in day enclosure on 3 shelves, before bonobos enter)

- 3 apples, 3 oranges, 3 bananas. lettuce. 3 carrots. 1 lemon. 2 grapefruits. 3 sticks celery. 1 onion.
- 10:30 Twigs and browse. Poplar. lime. hazel. rose. ash. bramble. beech. oak. willow. hawthorn. maple. birch.
When no browse is available, extra vegetables are given. Potato (raw or cooked). parsnip. turnip. swede.
- 12.00 Fruit juice as much as they want, usually approx. 2 pints per animal.
- 12.30 Pap (2-3 spoonfuls per animal) consisting of bran, curds or yogurt, honey and Evening Primrose oil, (10 drops per adult and 5 drops for juveniles).

Lunch (put in day enclosure on 3 shelves, before bonobos enter)

- 3 bananas. 3 apples. 4 oranges. 4 kiwi fruits. 2 carrots. 3 sticks of celery. 3 tomatoes. 1/4 cucumber.
- 2.00 Toasted brown bread with low fat margarine. Honey. 2 slices per adult. 1 slice for juveniles.
Tea (fed individually to each animal in their beds)

Per adult. 1 apple. 1 orange. 2 bananas. 2 tomatoes. 1 pear. 2 plums. chunk pineapple. few grapes. 1/4 cucumber. stick of celery. 2 leeks. 1/4 chinese cabbage or lettuce. 1 pomegranate. Other fruits as available: peaches, mandarins, melons, apricots, papaya, mango, lychees, passion fruits, paprika, sharon fruits, etc.

6.00 Skimmed milk as at 7.00 a.m.

Food supplements:

- * MINAMINO syrup is given twice daily. 10 ml per adult and 5 ml per juvenile. It is given neat by spoon and is extremely palatable.
- * Pregnant apes receive calcium and iron tablets.

Remarks:

- * The toast with margarine and honey was added to the diet as a vehicle for the margarine which we find beneficial to our regular chimpanzees to combat dry skin.
- * As there are long periods when suitable browse is available, extra vegetables have been introduced.
- * no variation in feeding times
- * if every scrap of food is eaten, the amounts are increased until just a little is left. We usually find 1/2 apple or orange uneaten. This we feel is an acceptable amount.
- * the feeding sites are not varied, the food fed in the day enclosure is put on three shelves, the bonobos collect what they want and carry it off to eat where they choose.

Water:

Fresh drinking water is available in the outside enclosure. When they do not have access to this the animals are offered water periodically during the day.

Enrichment:

Seed is scattered in the woodwool. Nuts and dried fruit in small cardboard boxes, paper bags or paper sacks, screw top plastic jars or cardboard tubes are hidden in crevices. A termite mound is provided. Sugar cane is given when available. A salt lick block has been introduced and we are working on a dispenser which the bonobos will be able to operate.

BONOBO FEEDING AT WUPPERTAL ZOO (4 adults, 2 juveniles)

11.00 (Food is distributed after cleaning, before releasing the animals into the day enclosure)

All kinds of vegetables and fruits, but in the morning the focus is more on root vegetables like carrots, celery, potatoes, kohlrabi, etc.

16.00 (Food is put in night cages before animals enter: 2 groups of 2 adults, young are always with their mothers)

All kinds of vegetables and fruits.

Food example for 1 adult: 3 apples, 3 bananas, 1/2 fennel, 1 pepper, 1/2 pear, 1 orange, 1 mandarin, 1 slice of ananas, 2 slices of bread, some grapes, 1 tomato.

Once a week 4 spoons of cooked minced meat, once a week 1 boiled egg per animal.

Drinks: three times a day 1 L of different types of tea
morning: for the whole group ca. 20 L?

Additionally nuts, raisins, primate pellets ('play food').

Food supplements:

- * once a week calcium powder (Calcipot) and a multi-vitamin (Multi-Bio-Weyx-in)

Remarks:

- * ca. 3 years ago we removed milk (Milupa) from the food scheme
- * no variation in feeding times
- * some food is left, mostly the less sweet stuff
- * we cannot feed lettuce and some kinds of foliage, this leads to diarrhea.
- * food is offered at different feeding sites.

Water:

Water is available all the time.

Enrichment:

There are different methods which are changed daily: raisins or other treats hidden in paper boxes, or in special plastic play tubes with holes, treats hidden in hay, seeds distributed over the entire enclosure floor...